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TITLE: The Temporal Relationship Between Intrafamilial Violence, Deployment, and Serious Mental Illness in US Army Service Members

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14. ABSTRACT Prior research has established an association between deployment and family violence, with insufficient evidence to identify when such violence occurs in relation to deployment and identification of mental illness in ADSM. This project will use: 1) longitudinal models to capture the temporal relationships between deployment, mental illness and family violence and 2) qualitative techniques to allow military stakeholders to evaluate Stage 1 findings and inform future interventions. This year we assembled our experts, obtained human subjects approvals, and acquired datasets. We now have our finalized cohort for our study period of interest. Our programmer is working intensively to clean the datasets so that we can link deployment/UIC/MOS records to substantiated reports of family abuse and medical claims data. Once this is done, we will move forward with formal data analyses and begin to answer our research questions. The last 3 months have been filled with progress and momentum, and we look forward to sharing results from our analyses in the upcoming months.					
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SECTION I - A BRIEF INTRODUCTION COVERING THE PURPOSE AND SCOPE OF THE RESEARCH EFFORT.

The last decade has been one of considerable stress to families of soldiers, who have sustained a 10-year combat effort involving prolonged, sequential deployments. The resulting deployment tempo created unique stressors on military families. While evidence suggests that military families themselves are not at increased risk for intrafamilial violence during peacetime, there is evidence that: (1) cycles of deployment may increase this risk; (2) this risk could be encumbered by the soldiers themselves, or by the spouse who is left behind to care for the family's needs; and (3) while prior data has demonstrated a cross-sectional association between deployment and intrafamilial violence, there remains a great need to understand the temporal relationships, the specific personnel at greatest risk, and how such information can lead to better targeting of preventative resources.

This proposal offers a mixed methods approach to better appreciate the challenges faced by military families, as well as potential strategies that will support them and thereby reduce the risk for intrafamilial violence that may be associated with deployment. An observational analysis (Stage 1) will determine the temporal relationships between deployment, mental health issues, and intrafamilial violence within military families, and evaluate the risk differences between soldiers with different roles and responsibilities. To be clear, this proposal does not seek to identify whether there is an association between deployment and intrafamilial violence. Rather, we will further advance the military's understanding of this association by identifying the temporal relationships between deployment and intrafamilial violence as well as discovering how other factors mediate and moderate this relationship. With this analysis, we can identify specific subgroups of families that are at greatest risk for intrafamilial violence and the timeframe in which their risk is greatest. In this way, policies within the Army can help to target resources more effectively to families at highest risk, moving away from a "one-size fits all" approach.

For the observational analysis, we will link personnel and deployment history with healthcare claims data and substantiated reports of spousal and child abuse. The team will pursue longitudinal analyses to:

- 1) Establish the temporal relationship between deployment, diagnosis of mental illness in soldiers and spouses, and events of intrafamilial violence.
- 2) Identify specific factors that may modify the temporal relationship, including individual factors (i.e., demographics, soldiers' prior health, unit, MOS), family factors (i.e., family size, compositing, family members' prior health history), and deployment factors (i.e. length, frequency, timing between, and role during)

To build upon those results, the team will then pursue a community-driven approach via qualitative study (Stage 2) in which targeted leadership and stakeholders within the Army will be asked to reflect on the results from the observational study, based on expertise and past experiences within the system, to provide structured feedback that will guide suggestions for future interventions. This mixed methods format offers the best approach to linking quantitative analyses with concrete stakeholder recommendations in order to develop appropriate interventions that can be feasibly implemented. For the qualitative study, we will create a structured qualitative approach that will emerge from Stage 1 findings and, with guidance from

our Army advisors, which allows community experts/stakeholders from within the Army to:

- 1) Provide a rich contextual interpretation of the findings generated in Stage 1.
- 2) Solicit recommendations from Army stakeholders that will enhance the successful implementation of future interventions arising from Stage 1 findings.

SECTION II – SUMMARY OF PROGRESS DURING YEAR 3

Personnel

- Michelle Ross, PhD- The addition of Dr. Ross builds on our existing bio-statistics expertise on staff. She has become an integral part of framing the longitudinal analysis plan for our study team.
- Lihai Song, MS- The addition of Mr. Song provides additional programming support to the study team. Mr. Song works with de-identified DMDC personnel data and de-identified medical claims data.
- Heather Griffis, PhD- Our residential demographer, Dr. Griffis is an integral part of the study team and the analysis phase we are currently working through. Dr. Griffis handles all de-identified data as we work through the current phase of the study. She has a background in health and mortality research as well as analysis of large datasets.
- Dr. Richard Gelles, PhD- Dr. Gelles from the University of Pennsylvania School of Social Policy and Practice has re-joined the team for the analysis and interpretation phase of the study and brings to the team internationally recognized expertise in domestic violence and child welfare.

Human Subjects Approvals

The study team submitted and received approval from the CHOP IRB for the annual continuing review of the protocol. Additionally, we received Continuing Review approval from the USAMRMC ORP HRPO

Key Partnerships

Over the past year, we continued to connect with individuals whose expertise we believe can add value and direction to our study. These include COL Cox, Dr. Robichaux, and Dr. Gable from the Family Advocacy Program. They added valuable input surrounding FAP reporting process. We also established a working relationship with Wendy Funk, an MDR data expert. Ms. Funk provided helpful recommendations during the data linkage phase of the study and insight surrounding the source(s) of medical claims.

The team will continue to build and strengthen our relationship with the Family Advocacy Program as we disseminate results in the next year. Likewise, we built a relationship with the Office of the Surgeon General, which has been helpful in planning future dissemination strategy.

Enhancing our security standards

Building on previous internal reviews of our security standards and protocols, it was

recommended that during the year we implement a new data management protocol to advance security measures. Following CHOP IRB approval, an updated System Security Verification (SSV), and an updated Data Use Agreement (DUA), received data was uploaded to a non-networked, offline, secure VDI (VMWare View 5.1).

- The MHS data will be stored within a non-networked, offline, secure VDI (VMWare View environment). User authentication will be provided by CHOP's Active Directory structure and leverages the password policies and integration of CHOP's HR systems for system access. An additional layer of protection will be provided by the VDI desktop pool in that view group will be further limited to named resources of the protocol, and the ability to access this resource external to the firewall (remotely) will be blocked. Restrictions to the VDI desktop include disabled admin privileges, USB, and printing to ensure security. The VDI desktop will be limited to decrypting SAS data files, as admin privileges will not be enabled to install additional applications. USB support will be restricted to the DVD drive to intake the data from providers, and functions such as printing or USB flash drive media support will be subsequently blocked. Activities on the desktop are logged to ensure security. All activities of the desktop are to be logged centrally via CHOP's ArcSight log aggregator, which provides an objective audit to ensure least privilege system access and adherence to CHOP's Acceptable Use of Technology Policy. CHOP manages all elements of the VDI sessions to ensure security. All elements of the VDI computing session remain within the confines of CHOP's professionally administered, geographically redundant datacenters with no local file storage. The VDI setup affords the protocol staff to decrypt the data from the DVD and place it directly to the appropriate NAS file share without the use of an external drive. The NAS, like the VDI infrastructure, is datacenter based and AD bound. The network transmissions are protected and all data at rest is encrypted and replicated. Data stored on the dedicated study VDI server will be encrypted. Access to this VDI will be limited to study staff that work with the data, and security software be installed to monitor and record every keystroke. No data will be stored on laptops at any time. After linkage of the required datasets, the working data file will be de-identified to minimize risk of breach of confidentiality

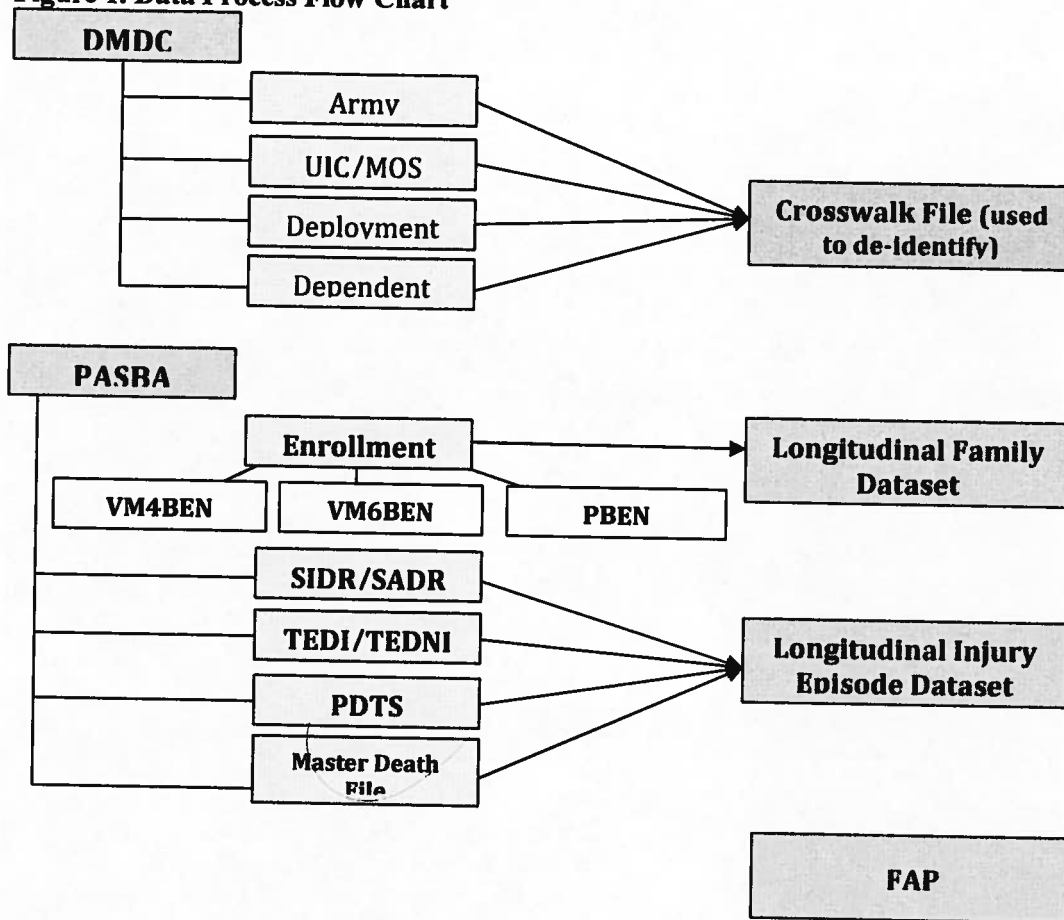
Data Acquisition

This year marked the completion of the data acquisition phase.

Data Preparation and Analysis

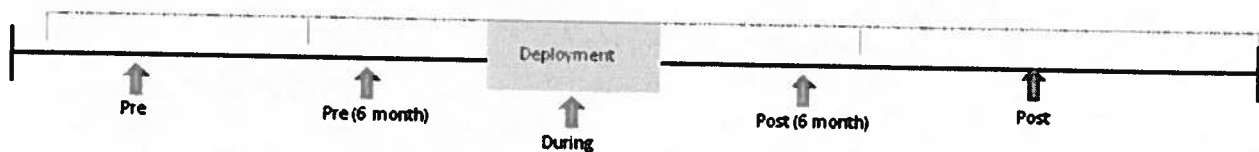
The completion of the final working dataset marks a significant milestone for the data team. Figure 1 details the complexity of the datasets that our programmers merged and created.

Figure 1. Data Process Flow Chart

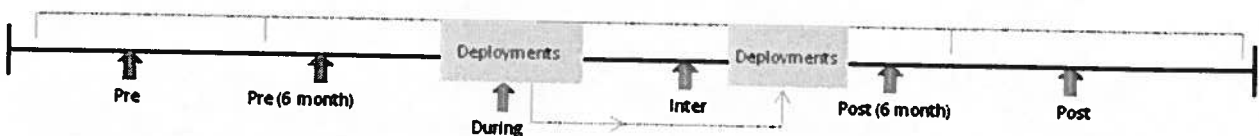


Using these datasets, the team completed cross sectional analyses of service member deployments and substantiated Family Advocacy Program (FAP) episodes among dependent children. By breaking down service member deployment periods (Figure 2), we were able to calculate rates of child abuse at various stages of the deployment cycle.

Figure 2. Deployment Periods:
 One Deployment:



Multiple Deployments:



In preparation for the longitudinal analysis, the data team created an innovative data structure based on different variables and their changes over time. At this point, the team has created five datasets: a time varying table, time invariant child table, time invariant service member table, time invariant FAP table, and time invariant injury episode table. Future analyses will require the addition of 4 datasets: a time invariant spouse table, a time invariant mental health of service member table, a time invariant drug and alcohol screening of service member table, and a time invariant pharmacy table. While the process of data organization is time-consuming, creating these tables will allow the analysis team to select desired variables from each table to create specific analytic data sets. This strategy also provides easier access and manipulation of the data due to large file sizes and will speed the process of data analysis in later stages. To further decompress the file sizes, a newborn baby cohort (all infants born in the study period: 09/2001-09/2007) was identified to simplify the interpretation of results across a subpopulation of children. Older children will be included in subsequent analyses.

Simultaneously, the team established the longitudinal framework for identifying injuries (and subtypes) across dependents. Using this framework, we broadened the analyses to identify rates of high risk injuries for child abuse in young children aged 0-2 years. The high risk injury (HRI) algorithm identifies serious episodes of injury and probable cases of child abuse using both TRICARE inpatient and outpatient claims data. Child injury episodes are defined using ICD-9 codes for traumatic injury (Appendix 1).

While FAP reports are our primary outcome, we have started examining the rates of injury and child abuse documented by medical providers. Building on early cross sectional results, the study team is examining the correlation between FAP reports and hospital based child abuse claims and related injuries. The analysis aims to identify child abuse and related injuries in the medical claims data and match them to their corresponding FAP report. Our goal is to describe the factors most predictive of early reporting to FAP after medical diagnosis of HRI or abuse.

Our team of mental health experts developed an algorithm for identifying definitive, probable and possible cases of PTSD from the TRICARE medical claims. This is a critical issue for the study because Army regulation and clinical practice changed significantly over the study period. Therefore, this algorithm takes into account the ICD-9 codes for PTSD, but also relies on other comorbid conditions as well as medications used to manage PTSD symptoms. This algorithm will act as a guide as we explore the data to identify cases of PTSD and other deployment-related conditions (Appendix 2). Our definition for PTSD has been validated by Gerlinde Harb, PhD, Dr. Richard Ross, MD, PhD, as well as behavioral specialists within the U.S. Army. Our definition is stratified into 4 categories: PTSD diagnosis, very likely PTSD, likely posttraumatic stress, and possible posttraumatic symptomatology. We also finalized our list of medications that we will use to guide our identification of PTSD cases as well.

Conclusion:

Our study population consists of 418,011 active duty service members (ADSM) and their nearly 1.2 million dependents across 580,000 unique families. Enlisted service members (E1-E4) account for 80% of our service member cohort. At the study start time (09/2001), 41% of ADSM are less than 24 years of age, 17% are 24-28 years of age, and 42% are greater than 28 years of age. Of the 1.2 million dependents, 61% are dependent children at some point during the study period and 36% are dependent spouses. Thirty-six percent of children are born during the study period. Of all ADSM in the study cohort, 71% of the cohort was deployed at some point during

the study period. Of those deployed, 97% experienced 1-3 deployments from 09/2001-09/2007 (Figure 3).

Results of cross sectional analysis show a proportional increase in FAP episodes during service member deployment. Additionally, our results show that risk periods for abuse are not solely confined to periods of service member deployment—prior to and after deployment show increased rates of abuse (Figure 4). Future longitudinal analysis will permit more refined analyses across other stratifying characteristics, including child age, soldier demographics, and deployment duration.

Supporting Data:

Figure 3. Deployments Experienced by ADSM and Dependent Children from 09/2001-09/2007

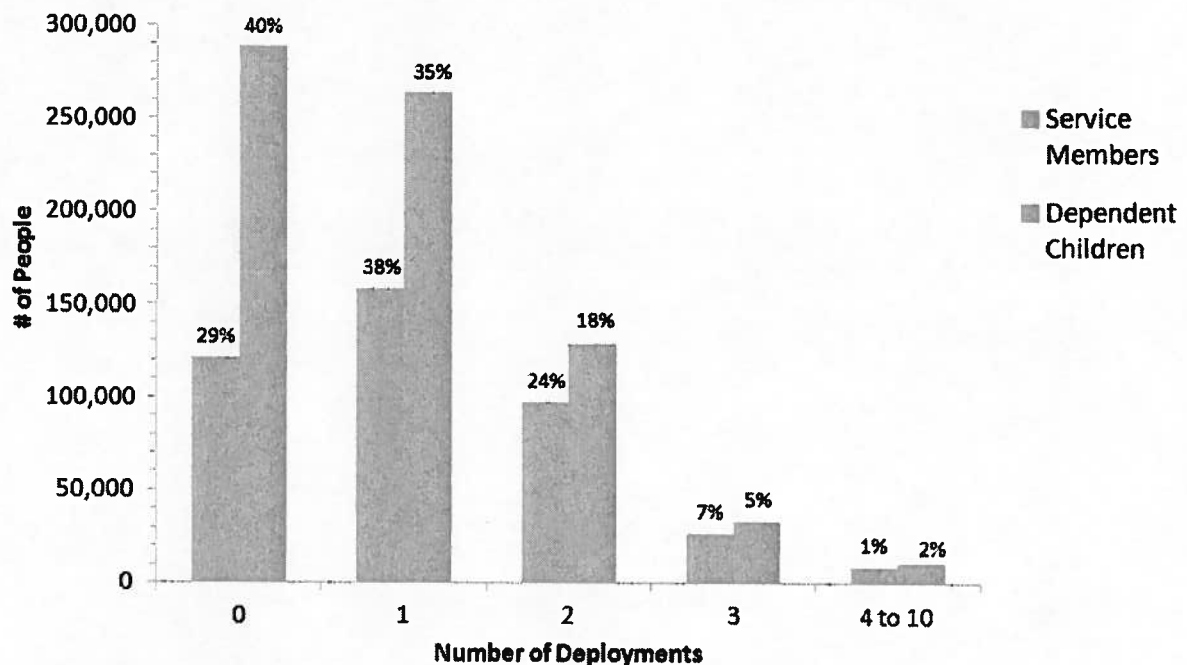
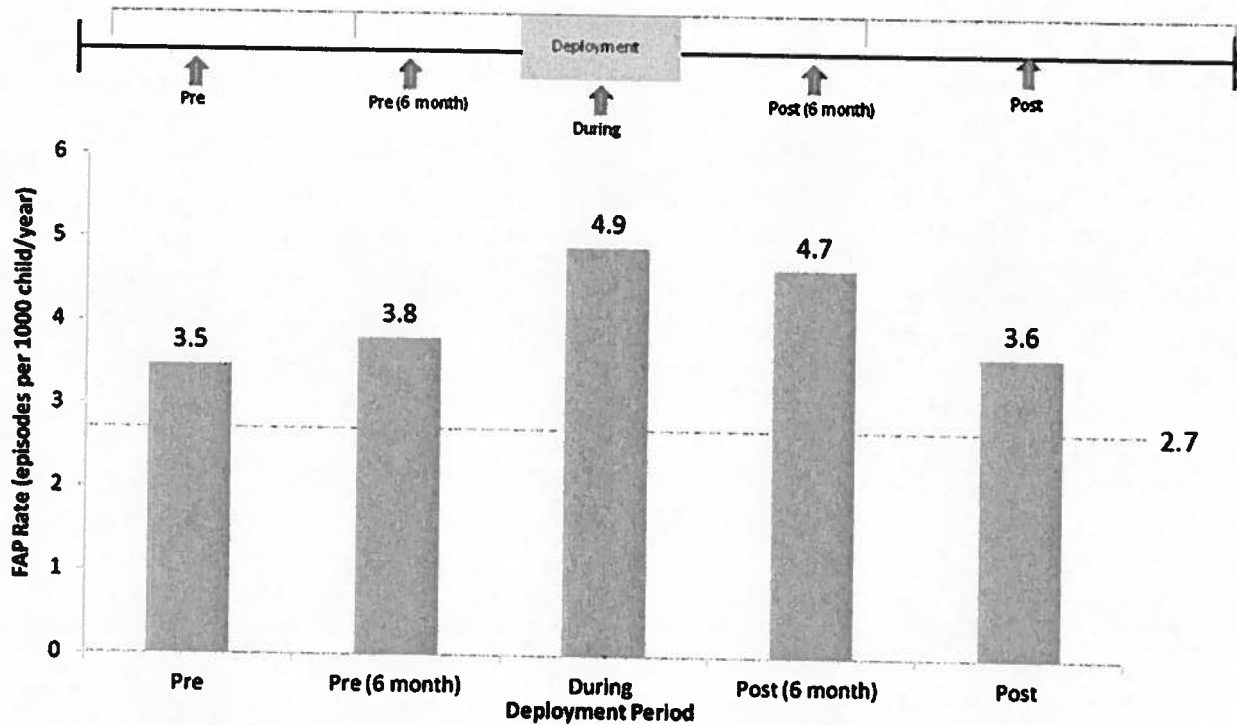


Figure 4. FAP Episode Rates for Children Experiencing 1 Deployment from 09/2001-09/2007



SECTION III - PROBLEM AREAS

- (a) A description of current and recent problems that may impede performance along with actions being taken to resolve them:

Due to the large size of the datasets, our team has recently established the most efficient data structure for longitudinal analysis that will give us flexibility to answer study research questions without creating a large, unmanageable master dataset. Corrective action included both sampling and creating a series of time varying and invariant datasets that can be merged at any point.

- (b) A description of anticipated problems that have a potential to impede progress and what corrective action is planned should the problem materialize:

The plans for future analysis include examining the relationship between spousal violence and service member deployment periods. During this phase, our team will encounter the same sampling obstacles that we currently experience with the child cohort. Our resolution will be to conduct a weighted sample matched on service member rank, age at entry to the study, race, education level, and sex of service member.

SECTION IV - DESCRIPTION OF WORK TO BE PERFORMED DURING THE NEXT REPORTING PERIOD.

1st Quarter Year 3 Goals (from SOW)	Status
Data acquisition	Complete.
De-identification of data and generation of crosswalk file	Complete.
Prepare data: Merge files, impute missing data, create variables for working dataset	Complete; created a series of time invariant and variant datasets to merge for each analysis.
Primary analysis (Y1Q2-Y3Q2)	In process; formal statistical analysis plan established; weekly goal-oriented statistical meetings; primary analysis in progress
Develop partnerships with key community stakeholders (Y1Q1-Y4Q4)	In process; continually building relationships to provide expertise in project context and dissemination.

SECTION V - ADMINISTRATIVE COMMENTS (OPTIONAL)

None.

Quarterly Technical Progress Reports shall be submitted to the following e-mail addresses within 10 days of the end of the report quarter. Please incorporate in the Subject Line of the e-mail the USAMRAA Grant/Cooperative award number associated with this award. The Quarterly Technical Progress Report shall be emailed to the following addresses:

Email: janet.kuhns@us.army.mil

Email: angela.m.martinelli.mil@mail.mil

References:

1. Matone M, O'Reilly ALR, Luan X, Localio AR, Rubin DM. Emergency department visits and hospitalizations for injuries among infants and children following statewide implementation of a home visitation model. *Maternal and Child Health Journal*. 2012 Dec;16(9):1754-61.
2. Wood JN, Medina SP, Feudtner C, et al. Local macroeconomic trends and hospital admissions for child abuse, 2000-2009. *Pediatrics*. 2012;130:e358-e364.

Appendix I: Injury Episode Algorithm-ICD-9 Codes

Injury Category	ICD-9 Code Range
Abuse	99550,99559, 99554,99555, E960, E961', E962,E963,E964,E965,E966,E967,E9680, E9681,E9682,E9683, E9685, E9686, E9687, E9688, E9689
Traumatic Brain Injury	8001,8002,8003,8004,8006,8007,8008, 8009,8011,8012, 8013, 8014, 8016, 8017,8018, 8019, 8031,8032,8033,8034,8036,8037, 8038, 8039,8041,8042,8043,8044,8046,8047,8048,8049, 851, 8520,8521,8522,8523,8524,8525,8530, 8531
Burns	940-949.9
Child Maltreatment	995.5
Crush Injury	925-929.9
Dislocations, Strains, and Sprains	830-848.9
External Cause	990-994.9
Femur Injury	82000,82001,82002,82003,82009,82010, 82011,82012,82013,82019, 82020, 82021, 82022,82030,82031,82032, 8203, 8208, 8209,82100,82101,82110, 82111, 82120, 82121,82122,82123,82129,82130, 82131,82132,82133,82139
Foreign Body	930-939.9
Fracture Lower Limb	820-827.9, 829-829.9
Fracture Neck and Trunk	805-809.9
Fracture Skull (apart from vault/base)	802-804.9
Fracture Skull Vault/Base	800-801.9
Fracture Upper Limb	810-818.9
Insect Stings	910.4, 910.5, 911.4, 911.5, 912.4, 912.5, 913.4, 913.5, 914.4, 914.5, 915.4, 915.5, 916.4, 916.5, 917.4, 917.5, 918.4, 918.5, 919.4, 919.5
Internal Trauma	855-869.1
Intracranial Injury	850-854.2
Multiple Fractures of Limbs	819-819.1, 828-828.1
Nerve and Spinal Cord	950-957.9
Open Wounds	870-897.9
Poisoning	960-989.9

Superficial Injuries and Contusion (apart from insect stings)	910-924.9, Exclude "Insect Stings"(9104, 9105,9114,9115,9124,9125,9134,9135, 9144,9145,9154,9155,9164,9165,9174, 9175,9184,9185,9194,9195
Vascular Injury	900-904.9
Motor vehicle Accident	E800,E801,E802,E803,E804,E805,E806,E807,E810, E811,E812,E813,E814,E815,E816,E817, E818,E819,E820,E821,E822,E823,E824,E825, E826,E827,E828,E829, E830,E831,E832,E833,E834,E835,E836,E837,E838, E840,E841,E842,E843,E844,E845,E48
Unspecified Injury (All Body Regions)	959
Child Abuse+ Poisoning+ Maltreatment	995.5- 995.55, 99559

High Risk Injuries for Child Abuse (in children ages 0-2)

- High Risk Injury Events
 - TBI, suspicious abuse, Femur diagnosis that occur in children < 1 year of age in a NON-MV accident
 - TBI trumps Femur fracture
 - Excludes bone and bleeding disorders

Appendix 2

Mental Health Variables (including ICD-9 codes)

Medications

1. Any psychoactive medication
 - a. Lifetime - ever prescribed
 - b. Current - current prescription
2. Psychiatric Treatment Medications
 - a. Antidepressants
 - b. Mood stabilizers
 - c. Antipsychotics
 - d. Sedative/hypnotics
 - e. Psychostimulants
 - f. Sleep medications/sleep aides
 - g. Prazosin
3. Pain Medications
4. Medications known to increase violent behavior
5. Medications used to treat substance abuse

Psychiatric Diagnoses

1. Any mental health diagnosis (ICD-9: 290-319, excluding 305.10 tobacco addiction)
 - a. Lifetime - ever received a mental health diagnosis
 - b. Current diagnosis: issue of lag after diagnosis is made
 1. PTSD: once diagnosed, carry it forward
 2. Other MH diagnoses: see each diagnosis for timing of "current" diagnostic status.
 3. If one diagnosis is followed by another same diagnosis later, fill in the intermittent time as current diagnosis (unless noted otherwise)
2. PTSD
 - a. Definite PTSD diagnosis (309.81):
either 1. or 2.:
 1. *One inpatient medical encounter* with the defining diagnosis of PTSD in *any* diagnostic position
 2. *Two outpatient medical encounters*, occurring on separate days, with the defining diagnosis of PTSD in *any* diagnostic position (There is *no date restriction*, i.e., a restriction on the length of the time interval between the two outpatient medical encounters)
 - b. Very Likely PTSD: must have 1+ prior deployment and one of the following:
 1. Prescribed Prazosin

2. Nightmare disorder diagnosis (307.47 nightmare disorder)
3. *One outpatient medical encounter* with the defining diagnosis of PTSD in *any* diagnostic position
- c. Likely posttraumatic stress: must have 1+ prior deployment and one of the following:
 1. Acute stress reaction diagnosis (308.0, 308.1, 308.2, 308.3, 308.4, 308.9) PLUS another visit within 6 months with SSRI or SSRI+ Quetiapine prescription (This may also capture soldiers with posttraumatic depression)
 2. Adjustment disorder diagnosis (309.0, 309.1, 309.24, 309.28, 309.3, 309.4, 309.82, 309.83, 309.89, 309.9) on two separate medical encounters, occurring on separate days within 6 months
 3. Prescriptions of SSRI and/or Quetiapine with a V code, V15.4 (History of psychological trauma) or an E code, E990-E999 (Injury Resulting From Operations Of War) (This may also capture soldiers with posttraumatic depression)
 4. Personality disorder diagnosis with V code V15.4 (History of psychological trauma) (This may also capture soldiers with personality disorders and/or childhood trauma)
- Timing:
 - Current diagnosis:
 - Once diagnosed definite PTSD, carry forward as current.
 - If “likely PTSD” and later “very likely PTSD” begin current Very Likely PTSD at the earlier diagnosis date
 - If “definite PTSD” after “very likely” begin current definite PTSD at earlier diagnostic date.
3. Mood disorders
 - a. Bipolar disorders: 296.00 – 296.16 and 296.4- 296.80
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - b. Major Depressive Disorders: 296.2x-.3x
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.
 - c. Dysthymic disorder: 300.4
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - d. Atypical or not otherwise specified mood disorders: 296.81 -296.99 and 311
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.

- Do not assume current diagnosis between 2 separate diagnoses at different times.
- 4. Anxiety disorders other than PTSD
 - a. 300.0 Anxiety states
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.
 - b. 300.01 Panic disorder
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - c. 300.2 Phobic disorders
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - d. 300.3 OCD
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
- 5. Psychotic disorders (excluding drug-induced)
 - a. Schizophrenia: 295.0x – 295.9x
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - b. Paranoid states: 297
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.
 - c. Psychosis NOS: 298
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.
- 6. Attention Deficit Disorder: 314
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
- 7. Violence-related diagnoses:
 - a. Conduct disorders: 312.0x-312.2x
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - b. Intermittent explosive disorder: 312.34
 - Timing:

- Current diagnosis: Once diagnosed, carry forward as current
 - c. Isolated explosive disorder: 312.35
 - Timing:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.
- 8. Personality disorders
 - a. 301.x Any Axis II diagnosis
 - b. 301.7 Antisocial PD
 - c. 301.83 Borderline PD
 - Timing all PDs:
 - Current diagnosis: Once diagnosed, carry forward as current
- 9. Sleep disorders
 - a. 347 Narcolepsy
 - Timing:
 - Current diagnosis: Once diagnosed, carry forward as current
 - b. 307.4 Specific disorders of sleep, non-organic origin
 - c. 307.42 Insomnia
 - d. 327.00- 327.09 Organic insomnias
 - e. 307.47 Nightmare disorder
 - Timing (all sleep disorders except narcolepsy):
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current diagnosis between 2 separate diagnoses at different times.

Substance Abuse

1. Diagnoses (excluding 305.10 tobacco addiction)
 - a. Alcohol:
 - i. Alcohol Dependence: 303
 - ii. Alcohol Abuse: 305.00-305.02
 1. In remission if 5th digit = 3
 - iii. Alcohol-induced psychoses: 291
 - b. Substances:
 - i. Drug dependence: 304
 - ii. Drug Abuse: 305.2x-305.9x
 1. In remission if 5th digit = 3
 - iii. Drug-induced psychoses: 292
- Timing:
 - Dependence:
 - Current diagnosis and no future diagnoses:

- Keep current diagnosis for 1 year (assuming “early remission” for 1 year), then assume remission (change to 303.x3 or 304.x3)
- Once diagnosed, always carry forward “in remission” dx
- Abuse:
 - Current diagnosis: only current in month it shows up as diagnosis.
 - Do not assume current abuse between 2 separate diagnoses at different times.
 - If receives a dependence diagnosis (303.x or 304.x) within a year of abuse diagnosis – keep abuse current for time between diagnoses.
 - Create new variable: history of abuse (ever had a diagnosis of abuse)
- Psychosis (291 and 292)
 - Current diagnosis: only current in month it shows up as diagnosis.
- 2. Treatment: use Drug & Alcohol Diagnosis variables that show up in this database as well.
- 3. Drug testing = random snapshot in time (not sure if useful at all)
- 4. Referral mechanism variable (what information will this give us?)

TBI

1. Barell Injury Diagnostic Matrix (CDC, 2005)¹
 - a. Type 3: No evidence of intracranial injury, no/unspecified LOC
 - b. Type 2: No recorded evidence of intracranial injury, LOC less than 1 hour
 - c. Type 1: Recorded evidence of intracranial injury or moderate/prolonged LOC (=severe TBI)
2. Mild TBI:
 - a. 850.0 Concussion with no LOC
 - b. 850.11 Concussion with LOC 30 minutes or less
- Timing:
 - Severe TBI (= Type 1)
 - Current diagnosis: Once diagnosed, carry forward as current.
 - Mild TBI and Type 1 and Type 2:
 - Current diagnosis: Current in month it shows up as diagnosis and only the following 12 months.
 - New variables after TBI:
 - Time since first TBI diagnosis
 - Number of TBI episodes
3. Specific nonpsychotic mental disorders due to brain damage:

¹ A classification of TBI approved in 2001 by the International Collaborative Effort (ICE) on Injury Statistics, and documented by the CDC. The Barell matrix standardizes data selection of injury cases for epidemiologic, clinical, and management analyses.

- a. 310.0 Frontal lobe syndrome
- b. 310.1 Personality change due to conditions classified elsewhere
- c. 310.2 Post-concussion syndrome
- d. 310.8 Other specified nonpsychotic mental disorders following organic brain damage (e.g. Involuntary emotional expression disorder)
- e. 310.9 Unspecified nonpsychotic mental disorder following organic brain damage